CLAIMS

1. An ultrasonic motor in which radial vibrations of a disc of electro-active material (7,11) are converted via at least one flextensional displacement amplifier diaphragm (6a,6b,13) into vibrations of the or each diaphragm (6a,6b,13) perpendicular to the plane of the disc (7,11), said diaphragm vibrations then being converted into rotary motion via frictional contact at a diaphragm/rotor interface (6b/4,11/14).

2. An ultrasonic motor as claimed in claim 1 wherein the disc of electro-active material (7,11) is a piezoelectric material, with an electrode of a conductive material deposited on each circular face of the disc.

3. An ultrasonic motor as claimed in 1 wherein the disc of electro-active material (7,11) is an electrostrictive material, with an electrode of a conductive material deposited on each circular face of the disc.

4. An ultrasonic motor as claimed in 1 wherein the disc of electro-active material (7,11) is a magnetostrictive material excited by an oscillating magnetic field.

5. An ultrasonic motor as claimed in claim 1 wherein the disc of electro-active material (7,11) is of a multi-layer construction with one or more layers of electro-active material interleaved with layers of conductive electrode material.

6. An ultrasonic motor as claimed in claim 1 wherein the or each flextensional displacement amplifier diaphragm (6a,6b,13) is bonded to

the surface of the electro-active disc (7,11) with an epoxy or a metal loaded epoxy.

7. An ultrasonic motor as claimed in claim 1 wherein the or each flextensional displacement amplifier diaphragm (6a,6b,13) is bonded to the surface of the electro-active disc (7,11) with an anaerobic adhesive or modified anaerobic adhesive.

8. An ultrasonic motor as claimed in claim 1 wherein the or each flextensional displacement amplifier diaphragm (6a,6b,13) is soldered or diffusion bonded to the surface of the electro-active disc (7,11).

9. An ultrasonic motor as claimed in claim 1 wherein a respective diaphragm (6a,6b) is attached to each side of the disc (7) and a single rotor (4) positioned opposite one of the diaphragms (6b) turns about an axle(1) which is attached to the other diaphragm (6a).

10. An ultrasonic motor as claimed in claim 1 wherein a respective diaphragm (6a,6b) is attached to each side of the disc (7) and a respective rotor (4a,4b) is arranged opposite each diaphragm (6a,6b) of which one rotor (4b) is attached to an axle and the other (4a) can slide axially along the axle.

11. An ultrasonic motor as claimed in claim 1 wherein an axle (1) is attached to the electro-active material disc (7,11) and one or more rotors (4a,4b,13) turn about said axle (1) on bearings (10,17).

12. An ultrasonic motor as claimed claim 1 wherein one or more rotors (4a,4b,14) are held in contact with the displacement amplifier

diaphragms' (6a,6b,13) oscillating surfaces utilising magnetic attraction, when this magnetic attraction is brought about by the rotors (4a,4b,14) having a remnant magnetic polarisation and the diaphragms (6a,6b,13) being made of ferromagnetic materials, such as the metals Iron, Nickel or Cobalt or their alloys.

13. An ultrasonic motor as claimed in claim 1 wherein one or more rotors (4a,4b,14) are held in contact with the displacement amplifier diaphragms' (6a,6b,13) oscillating surfaces utilising magnetic attraction, when this magnetic attraction is brought about by the diaphragms (6a,6b,13), having a remnant magnetic polarisation and the rotors (4a,4b,14) being made of ferromagnetic materials, such as the metals Iron, Nickel, or Cobalt or their alloys.

14. An ultrasonic motor as claimed in claim 1 wherein one or more rotors (4a,4b,14) are held in contact with the displacement amplifier diaphragms' (6a,6b,13) oscillating surfaces utilising magnetic attraction, when this magnetic attraction is brought about by an electromagnet winding.

15. An ultrasonic motor as claimed in claim 1 wherein one or more rotors (4a,4b,14) are held in contact with the diaphragms (6a,6b,13) by one or more springs.

16. An ultrasonic motor as claimed in 1 wherein the displacement amplifier (6a,6b,13) diaphragm and electro-active disc (7,11) assembly is the rotating component and the rotor (4a,4b,14) is the stationary component.

17. An ultrasonic motor as claimed in 1 wherein the displacement amplifier diaphragm (6a,6b,13) and electro-active disc (7,11) assembly is the stationary component and the rotor (4a,4b,14) is the rotating component.

18. An ultrasonic motor as claimed in claim 1 wherein a layer or structure of an elastic material is attached to the surface of the rotor/diaphragm interface (5,5a,5b).

19. An ultrasonic motor as claimed in claim 1 wherein elastic fins (5,5a,5b) are provided at the interface that each have a fin tip which contacts the friction interface such that, the fin tip has an instantaneous rotation about a rotation point not in line with the fin tip contact point in the direction of rotation, thus causing a horizontal friction reaction which drives the rotor (4,4a,4b,14) on the expansive stroke of the displacement amplifier (6a,6b,13), yet allows the fin to relax on the downstroke and the fin tip to slide on the friction interface.

20. An ultrasonic motor as claimed in claim 19 wherein the elastic fins (5,5a,5b) make a contact at an oblique angle to the surface of the friction interface between the rotating component and the diaphragm (6a,6b,13) of the stationary component.

21. An ultrasonic motor as claimed in claim 19 wherein the elastic fins (5,5a,5b), which make contact with the friction interface, have one or more curved sections in their length.

22. An ultrasonic motor as claimed in claim 19 wherein the elastic fins (5,5a,5b), which make contact with the friction interface, have at least two straight sections that are joined in at an angle.

23. An ultrasonic motor as claimed in claim 1 wherein the or each flextensional amplifier diaphragm (6a,6b,13) is dish-shaped with an upset central region.

24. An ultrasonic motor as claimed in claim 23 wherein the central region is spaced from the plane of the disc.

25. An ultrasonic motor as claimed in claim 23 wherein the central region (13a) is contained within the plane of the disc.